Description

1. Title of the Invention

METHOD OF PRODUCING STRETCHED FILM OR SHEET

2. Claim

(1) A method of producing a stretched film or sheet, characterized in that a synthetic resin film or sheet is stretched in a direction intersecting diagonally with the longitudinal direction of the film or sheet by making the film or sheet move as both edges of the film or sheet are gripped with a double row of chucks travelling on tenter rails arranged so that the chucks have different distances traveled in a specified travelling section.

3. Detailed Description of the Invention

(Industrial Field of Application)

The present invention relates to a method of producing a stretched film or sheet. More specifically, the invention is concerned with a method of continuously stretching a film or sheet at an oblique angle.

(Prior Arts)

Although obliquely stretching methods have so far been reported, it is difficult to continuously make an obliquely oriented film or sheet. For instance, in JP-B-40-5319 to Du Pont is disclosed the method of stretching a film while rotating a mandrel in tubular stretch. However, the tubular stretch itself is difficult, and besides, the rotation of the mandrel

in the case of oblique stretch tends to cause slanting wrinkles in the film, rendering the continuous stretch more difficult. Further, the use of a mandrel has a drawback of damaging the film surface. Another method is disclosed in JP-B-58-33090 to Hercules. Therein, a film stretched in a lateral direction by means of a tenter is stuck on a film stretched in a longitudinal direction by means of a roll. In this case, two devices are required, and the intersecting angle that can be formed is a 90° angle alone because the directions of stretch are longitudinal and lateral.

In JP-A-50-83482, on the other hand, there is a proposal of using chucks moving at different speeds. In this case, control of moving speeds of chucks is not easy and a complex device is required therefor.

(Problems that the Invention is to Solve)

With the intention of solving the foregoing problems, the invention is concerned with a method wherein an obliquely stretched film, which is uniform and free of damage at the surface, is formed continuously by the use of a tenter.

(Means for Solving the Problems)

The gist of the present invention relates to a method of producing a stretched film or sheet, characterized in that a synthetic resin film or sheet is stretched in a direction intersecting diagonally with the longitudinal direction of the film or sheet by making the film or sheet move as both edges

of the film or sheet are gripped with a double row of chucks travelling on tenter rails arranged so that the chucks have different distances traveled in a specified travelling section.

An example of the present method is illustrated below in more detail by the use of a drawing.

Figure 1 is a diagram illustrating an example of apparatus used in the present method.

In the figure, 1 and 1' denote tenter rails, and 2 denotes a film or sheet.

As shown in Figure 1, the principle of the invention consists in curving the tenter lines and utilizing a difference between distances traveled on the outer tenter rail and the inner tenter rail. When the curvatures of the inner and outer tenter rails are taken as r_2 (distance *O*-a') and r_1 (distance *O-a*) respectively and the angle of the arc is taken as θ (angle *aOb*), the chuck travelling on the outer tenter rail lags behind the chuck travelling on the inner tenter rail as far as both chucks are made to move at the same speed. And the greatness of the lag results in $\theta(r_1-r_2)$. Since r_1-r_2 is the tenter width, the lag of the chuck travelling on the outer tenter rail is a value obtained by multiplying the tenter width by θ. If we set just $\theta = 1$ radian (57 degrees), a continuous film in which molecules are aligned at the angle of 45° can be obtained. When required, the angle of molecular alignment in the film or sheet 2 can be arbitrarily changed by varying the angle of the arc

or the relative travelling speeds between the inner and outer chucks. From the viewpoints of operability and consistency, however, it is appropriate that the travelling speeds of the inner and outer chucks be almost equal.

Further, the film or sheet 2 can be stretched in advance in the lateral (or crosswise) direction before it reaches the curved section of the tenter.

When the film or sheet 2 having undergone the aforementioned oblique stretching is folded in two and bonded, a laminated film or sheet can be obtained wherein stretch alignments intersect with each other and the strength in longitudinal direction is almost the same as the strength in the lateral direction.

Additionally, before it enters into the curved section of the tenter, the film or sheet 2 may undergo biaxial stretching to some extent, or may undergo biaxial stretching first and then stretching in the longitudinal direction so to have relatively intense alignment in the longitudinal direction. To the thus stretched film or sheet, the present method can also be applied.

Further, in the curved section, it is possible to stretch in a shape like an open fan. In other words, it is also possible to make the distance 0-b longer than the distance 0-a, or make the distance 0-b′ shorter than the distance 0-a′.

Examples of a film or sheet material to which the present

method can be applied include all the materials generally known to be stretchable, such as polyethylene, polypropylene, polyvinyl chloride, polycarbonate and polyester.

(Examples)

Now, the present invention will be illustrated in more detail by reference to the following example. However, the invention should not be construed as being limited to the following example so far as changes and modifications are within the scope of the invention.

Example 1

By using the apparatus shown in Figure 1, a polyethylene terephthalate sheet was subjected to 2.4 times stretching in the lateral direction at a temperature of 55°C, and then conducted to tenter rails curved so as to have an r_2 (distance O-a') value of 90 cm, an r_1 (distance O-a) value of 160 cm and a θ value of 57 degrees. In this curved section, the sheet was stretched under a temperature of 90°C. Additionally, r_2' (distance O-b') was adjusted to the same distance as r_2, and r_1' (distance O-b) was adjusted to the same distance as r_1.

The birefringent index and the alignment direction of the thus stretched film were measured. The measurement results are shown in Table 1. In the areas along the peripheries of chucks, however, the film became non-uniform because it was not stretched or hardly stretched. Therefore, the measurements were made at the midpoint of the film and the positions 10 cm

away in the left and right directions respectively from the midpoint.

Table 1

Measurement position on film	Alignment angle (degrees)	Birefringent index
side (inner)	44	0.105
Midpoint	45	0.100
side (outer)	46	0.100

The alignment angle and the birefringent index were each almost constant, irrespective of the measurement position on the film.

As a result of drawing a line in quick drying ink between the chucks provided on the left and right sides of the film in a direction perpendicular to the flow of the film at the positions a and a′ nearby the tenter inlet, the line was extruded from the tenter outlet in the state of an inclined straight line marked between the chucks as anchor points (a straight line intersecting the travel direction of the film at an oblique angle) since the outer chuck was behind with its travel in the curved section.

(Effects of the Invention)

Only by folding a film obliquely stretched according to the invention in two and bonding together, an orthogonalized laminated film can be obtained, which can have alignment

directions intersecting with each other and satisfactory strength in both lateral and longitudinal directions.

Further, when a film having birefringence is sandwiched between polarizing films made into a cross Nicol's prism, color due to interference of light appears. By bonding these films in combination, a film having a unique impression of color, which cannot be made by dyeing, can be obtained. In order to slit this film into fiber-like strips 0.5 mm in width and weave them into a textile, a long continuous film is required. In accordance with the invention, the stretched films necessary for the foregoing cross Nicol's prism and the film sandwiched between them can be continuously produced with ease.

(Brief Description of Drawing)

Figure 1 is a schematic diagram illustrating an example of apparatus used for the present method.

In Figure 1, the numeral 1 represents a tenter rail, and the numeral 2 represents a film or sheet.

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